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## Do Production Support Policies are Effecting the Vegetable Planting Scale? Evidence from Xingtai City, China

Debin Zhang<sup>a\*</sup>, Lanxin Deng<sup>a\*</sup>, Shuo Wang<sup>a</sup><sup>a</sup> College of Public Administration, Huazhong Agricultural University, Wuhan, 430070, People's Republic of China

## ARTICLE INFORMATION

*Article history:*

Received 09 February, 2022

Received in revised form 26 February, 2022

Accepted on 28 February, 2022

*\*Corresponding authors:*

Deng Lanxin

2219425724@qq.com

Debin Zhang

zhangdb@mail.hzau.edu.cn

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## ABSTRACT

The development of the vegetable industry is inseparable from the support of policies. At present, the agglomeration of the vegetable industry is continuously optimized, while industrialization and scale are constantly evolving. In order to explore the impact of production support by local government policies on the scale of vegetable planting, and the problems existing in these policies, this research estimates the efficiency of policies production support on vegetable cultivation. To this end, an overview of the vegetable production policies and measures in the main vegetable-producing areas in Xingtai, Hebei province was conducted. The structural equation model was applied to test the relationship and extent of vegetable production support policies on the vegetable planting scale. Results of the research showed that the production support policy has a positive effect on the degree of vegetable price fluctuation and the scale effect does exist, while the direct effect on the scale planting was not significant. However, the indirect effect of taking the degree of price fluctuation as the intermediary variable was significant. It indicates that production support policies may affect scale through the degree of price fluctuations. Policymakers should improve the policy system, and increase the content of subsidies. Promote cooperation between small-scale farmers and large-scale business entities.

**Keywords:** Production support policy; Large-scale; Mediation effect; Price fluctuation; China

### 1. Introduction

As a representative of fresh produce, vegetables are easily affected by the weather and seasonal impact, which sometimes leads to the vegetable market prices fluctuating greatly with both farmer profit and consumer interest loss. Thus, it would be better to rely on government forces for regulation, rather than rely on the adjustment of the market only. Since the reform and opening-up, China's vegetable industry has developed rapidly. The production level and safety of vegetables have been significantly improved. The marketing circulation system is improved to be more and more efficient and flexible. And the vegetable industry policy system is also constantly improved. According to statistics, in 2020, China's sown area of major crops reached 167,487 thousand hectares, among which the sown area of vegetable melons was 22,556 thousand hectares, and China's total vegetable output was 749.129 million tons<sup>[1]</sup>. The No.1 Document of China's Central Government in 2020 proposed to further improve the agricultural subsidy policy<sup>[2]</sup>. The No.1 Document of China's Central Government in 2021 emphasized the need to accelerate agricultural modernization and strengthen support for modern agricultural science and technology<sup>[3]</sup>.

In order to support the development of the vegetable industry, the central and local governments in China have issued a large number of policies to cover the vegetable production links (Huang and Ding 2016), which mainly include agricultural infrastructure construction, quality and safety strengthening policies, agricultural insurance subsidies, construction of information and technology level and so on. Therefore, the research on vegetable production support policy may have some theoretical and practical significance to the development of the vegetable industry.

China's vegetable industry agglomeration and scale process continue to advance. The vegetable production areas in China are mainly distributed in South China, Yangtze River Basin, Southwest, Northwest, Northeast, Huanghuaihai river, and Bohai Rim (Ji et al., 2018). Agricultural production cooperatives, large growers, family farms, and leading enterprises are the primary operators of large-scale vegetable planting, which grow continuously (Wang and Hu 2016). Meanwhile, with the development of vegetable industry agglomeration and the expansion of large vegetable business entities, various large-scale business models of vegetables continue to

<sup>[1]</sup> Data source: State Statistical Bureau. The Statistical Yearbook of China (2020).

<sup>[2]</sup> Opinions of the CPC Central Committee and The State Council on the key work in the areas of agriculture, rural areas and farmers to ensure the realization of a moderately prosperous society in all respects as scheduled. 2020.

<sup>[3]</sup> Opinions of the CPC Central Committee and The State Council on Comprehensively Promoting Rural Revitalization and Accelerating Agricultural and Rural Modernization. 2021.

develop. The market for small-growing farmers has been squeezed and the aging of the population leads to a shortage of rural labor supply. Under this circumstance, the local government conducts market regulation through policy guidance, thereby ensuring the advantages of the vegetable industry, expanding the circulation, improving the income of the vegetable business, and promoting the large-scale development of the regional vegetable industry. It is worth studying that whether the vegetable production support policy implemented by the local government plays an important role in the scale of vegetables in the process of promoting the large-scale development of the local vegetable industry. Therefore, this paper will explore how the vegetable production support policy affects the scale development of the regional vegetable industry.

Based on the actual development of the regional vegetable industry, local governments have implemented a series of vegetable production support policies. Scholars have made a series of analyses on the implementation of the vegetable production support policy. The current vegetable production support policies include financial investment (Prosperi et al., 2021), policy-based financial and credit insurance (Yang and Li 2019), cultivating new technology and new management mode, optimizing the structure of the facility (Song and Robinson 2020), construction of the high-standard industrial park, establishing vegetable market information exchange platform, farmers' experience, and skills training (Shrestha et al., 2016) and so on. On the impact of support policies for vegetable production, local vegetable production support policies are poorly coherent and cannot meet the policy objectives (Marcu and Meghisan 2015). The subsidy standard is low, the county public services are under great pressure (Kneafsey et al., 2013). The subsidy system is not strong enough and lack of effective supervision (Yang et al., 2019). The local financial subsidy capacity is insufficient, with less scope and variety of subsidies (Yang and Li 2019).

In view of a series of problems existing in China's current vegetable industry policy, scholars believe that financial investment should be increased and subsidies for the vegetable industry to benefit farmers should be expanded (Dong et al., 2019). A vegetable policy-based insurance system should be established (Prosperi et al., 2021). The system of institutional norms should be improved, ensuring that policies to benefit farmers are fully implemented (Qiang et al., 2019). Build a vegetable information platform to make vegetable

planting and sales information more transparent (Shrestha et al., 2016).

The scale of vegetable cultivation is influenced by both internal and external factors. External factors such as policy environment, market conditions and production, and operating environment will affect the vegetable planting scale. From the perspective of policy factors, various subsidy support policies will affect the expansion of the vegetable planting scale (Zhang et al., 2020). Supporting policies and a perfect market system provide important conditions for the scale of the vegetable industry (Song and Robinson 2020). Agricultural production technology training can significantly enhance the willingness of farmers to expand their planting scale (Schreinemachers et al., 2016). In addition, the scale of vegetable planting is also affected by the age of farmers, the number of the family labor force (Wang and Hu 2016), household income, behavioral preferences (Yang and Li 2019), and other household internal factors.

Promoting the large-scale development of the vegetable industry cannot be isolated from policy support. The current overall effect of the vegetable industry scale is insufficient. Market information lags behind, and the production organization is weak (Mariyono 2018). Vegetable planting varieties and production methods are backward (Ji et al., 2018). In order to better promote the regional vegetable industry scale, it's better to expand the role of policy in benefiting farmers in land transfer, production base construction, quality supervision, technology promotion, and other aspects (Dong et al., 2019). Constantly improve market information construction and promote brand incubation (Huang and Ding 2016).

In summary, previous research has emphasized the impact of policy support on the scale of vegetable industrialization, which has analyzed the problems existing in the vegetable production support policy and the obstacles to the large-scale development of the vegetable industry. But in general, the current production support policy on vegetable scale production research is less, mostly focusing on bulk agricultural products such as grain and oil, as well as agricultural scale operation model. We will explore the impact of production support policies on the vegetable planting scale in practice. Start from the implementation of vegetable production support policy of main vegetable producing areas in Nanhe district, Xingtai city, Hebei province, China. Use structural equations to test the relationship and degree of fresh production

support policy on the vegetable planting scale through field research. Thus to find out the shortcomings of the current vegetable production policy and the possible future development direction.

## 2. Material and METHODS

### 2.1. Selection of the study area

This study was examined in the Nanhe district, Xingtai city, Hebei province, China, which is situated in the North China plain. The total population is 350,400. And it covers an area of 418 square kilometers, among them, the arable land area is about 300 square kilometers, with 69.3 square kilometers of vegetable planting area<sup>[4]</sup>. The Nanhe district continuously promotes the progress of rural revitalization work under the guidance of science and technology and adjusts the agricultural planting structure actively. And the Nanhe district vigorously develops characteristic agriculture such as the planting of facility vegetables, flowers, and Chinese medicinal materials, which help increase agricultural efficiency and farmers' incomes. The Ministry of Agriculture and Rural Affairs identified Nanhe district as a demonstration county for basically realizing the full mechanization of major crop production in December 2020. Nanhe district was rated as a demonstration county for pest control in April 2021. The vegetable industry in Nanhe district is relatively mature, mainly with open-ground vegetables and greenhouse vegetables. The vegetable planting is mostly made by families, followed by vegetable production cooperatives. The vegetable industry agglomeration is obvious. Greenhouse vegetable production in Nanhe district is mainly gathered in the East Zhengzhuang Village, Qie village, and Southeast Zhang Village. The greenhouse is dense, and the planting varieties are relatively concentrated, concluding with cucumber, tomato, courgette, pepper, potato, etc.

In recent years, the Nanhe district has taken the development of the vegetable industry as the focus development and taken a series of effective measures to increase the poor income in the vegetable industry. In 2016, the Nanhe County Government cooperated with China Agricultural University to build the Nanhe Agricultural Carnival and invested 17.164 million yuan in leading enterprises to distribute dividends to poor families and drive farmers to generate income.

The Implementation Plan of the 2018 Vegetable Industry Development Subsidy Project in Nanhe County was formulated in 2018. The construction of high-end facilities, brand promotion, green and ecological cultivation, and other links were subsidized, which drive the upgrading of the county vegetable industry. The Nanhe County Government invest 3.22 million yuan with financial funds to build a mushroom ecological industrial park and improve the ability of the vegetable industry to alleviate poverty and increase income.

For the general vegetable growers, the local vegetable production support policies mainly include greenhouse construction loans, greenhouse insurance, greenhouse subsidies, grassroots agricultural technology extension service, etc. General farmers can enjoy less production support policies than rural poor households. In addition, the field investigation found that most vegetable farmers had not received any subsidies, and a few farmers had received subsidies once or twice. At the same time, some farmers reported that the loans were interest-bearing loans, the greenhouse insurance compensation was small and high handling fee, and the frequency of technical promotion services was less. General growers are in a weak position in the supply chain. The vegetable market price fluctuates greatly, and the income of ordinary farmers is easily affected by the market situation. It's easy to lose profit with neither production subsidies, nor good sales channels, which affects the enthusiasm of farmers to expand the production scale.

### 2.2. Model hypothesis

Farmers' planting decisions are not only affected by internal factors such as land resources (Liao et al., 2019), labor force, and self-owned funds (Rana 2021), but also by external factors such as subsidy policies (Qian et al., 2020), taxation (Shrestha et al., 2016), market conditions and information level (Mariyono 2018). To improve profits and change the management level of family vegetables, farmers may choose to expand the scale of vegetable planting under the influence of policy subsidies, stable market prices, and changes (Qian et al., 2020) to obtain higher returns from supply and demand. Based on the existed research of past scholars, the production support policy, price fluctuation degree and scale effect are taken as the independent variables, and the scale planting is taken as the dependent variable to build a theoretical model. The

<sup>[4]</sup> Data source: <http://nync.xingtai.gov.cn/>

following are the variable explanations for this study.

The production support policy refers to a series of measures provided by local governments to improve the vegetable business environment, reduce the economic burden of farmers, improve the enthusiasm for vegetable planting, and promote the development of the regional vegetable industry (Ding and Rebessi 2020). It mainly includes vegetable field infrastructure construction, greenhouse insurance, technology promotion and training construction, etc.

The price fluctuation degree is the signal of vegetable market change, which is directly related to the planting income of farmers. The drastic price fluctuations will affect the economic benefits of farmers, thus affecting their planting and management decisions in the next year (Kong et al., 2019). Therefore, the degree of price fluctuation has an important impact on farmers' planting scale decisions. The scale effect refers to the internal economic benefits brought by the expansion of land scale, the appropriate amount of production means and agricultural technology, the improvement of land output rate, as well as the external economic benefits brought by the continuous improvement of the agricultural division of labor and service system (Zhang et al., 2020). Large-scale planting refers to the behavior of farmers choosing to expand the planting scale or join professional cooperatives to improve the planting organization degree under the influence of various factors such as individual, family, market environment, and policy environment.

In view of the influence of production support policy on large-scale vegetable planting in this study, all of them are relatively abstract concepts, which can only be compared with a large amount of data and cannot avoid the bias caused by subjective evaluation. Thus it is more suitable to use the structural equation model for evaluation. For this consideration, we construct a structural equation model of the influence mechanism of production support policy on large-scale vegetable planting (Figure 1) to test the research hypothesis.

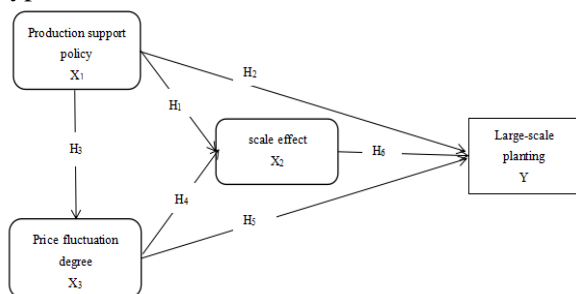


Figure 1. Structural equation model and assumptions

Production support policies can be understood as a series of producer support policies provided by the government to support vegetable production, such as industrial awards and subsidies, policy-based vegetable insurance, agricultural machinery purchase subsidies, industrial training, etc. Demirdogen et al., (2016) analyzed the farm data in two regions of Turkey and found that food subsidies had a significant impact on the motivation to grow food crops. Based on the survey of farmers in Liaoning Province, it's found that the agricultural subsidy level has a significant positive impact on the comprehensive efficiency and scale effect of farmers' production and operation (Shrestha et al., 2016). As a representative of fresh agricultural products, vegetable yields have a great impact on the planting scale, technology, and climate. Scholars have mentioned the positive impact of production support policies on the planting scale behavior and planting scale effect of agricultural products. Therefore, concerning similar studies, Hypotheses 1 and 2 are proposed:

Hypothesis 1: Production support policy has a significant positive impact on the scale effect.

Hypothesis 2: Production support policy has a significant positive impact on large-scale planting.

Vegetable price fluctuation is affected by season, weather, and market supply, the information asymmetry also exists in the supply chain of agricultural products, leading to the asymmetry between vegetable prices and their planting scale. For a period of time, scholars are controversial about the price regulation effect of the vegetable policy. With the continuous development of the policy, its regulation effect on the vegetable market price is becoming more and more obvious. Ding (Ding and Rebessi 2020) analyzes the effect of EU agricultural policies and concludes that transfer payments have a regulating effect on agricultural prices. Some scholars also simulated the prices of five types of vegetables, which proved that the policy regulation measures can effectively reduce the fluctuation range of vegetable prices. It is found that compared with other links, the regulation policy of the production link lasted the longest, which has a positive effect on the price increase of the vegetable market (Kong et al., 2019). Referring to similar studies the scholars, hypothesis 3 is proposed.

Hypothesis 3: Production support policy has a significant positive impact on the degree of price volatility.

Table 1. Design of this study scale.

latent variable	Observed variable number	Observational variable questions	mean value	standard deviation	Item reference source
Production support policy	PSP1	The government provides financial support (industrial subsidies and financial credit support).	3.02	1.029	(Qian, Ito, and Zhao 2020)
	PSP2	The government provides construction support for infrastructure (agricultural machinery purchase subsidy, vegetable standardized park construction subsidy...).	2.89	0.986	
	PSP3	The government conducts industrial training and policy publicity.	3.49	0.996	
	PSP4	At present, there are many channels to obtain vegetable production policy support, and the procedure is simple.	2.64	0.828	
Scale effect	SE1	The income of vegetable planting is affected by the planting scale.	4.05	0.646	(Zhang et al., 2020)
	SE2	Farmers with large-of vegetables are more likely to benefit.	3.87	0.66	
	SE3	The government encourages farmers to expand the scale of vegetables and gives corresponding support.	2.63	0.721	
Price fluctuation degree	PFD1	Vegetable planting is easily affected by the fluctuation degree of vegetable market price.	4.5	0.608	(Kong et al., 2019)
	PFD2	The fluctuation degree of vegetable price will affect the planting scale of farmers.	3.73	0.985	
	PFD3	The government has carried out policy regulation to stabilize the vegetable market prices.	2.63	0.766	
Large-scale planting	SP1	Expanding vegetable planting scale can increase family income.	3.91	0.722	(Bovay and Sumner 2018)
	SP2	Expanding the scale of vegetable planting is in line with the current market situation.	3.52	0.673	
	SP3	There are currently plans to expand the scale of vegetable planting.	2.97	0.97	

As fresh products, vegetables are easy to be affected by market price fluctuations, prone to the vegetable unsalable phenomenon. Policies are playing a more and more role in regulating vegetable prices. The relatively stable fluctuation of vegetable prices can benefit all the subjects of the supply chain. When vegetable prices change, it will have different effects on farmers of different planting sizes (Qian et al., 2020). So, in the case of stable prices, whether farmers can expand their income can be realized by expanding the planting scale. Therefore, hypotheses 4 and 5 are proposed.

Hypothesis 4: The degree of price fluctuation has a significant positive impact on the scale effect.

Hypothesis 5: The degree of price fluctuation has a significant positive impact on large-scale planting.

The income of vegetable planting is affected by the planting area, output, input cost, market price, and other aspects. Among them, large vegetable growers are easier to make profits than small farmers. (Bovay and Sumner 2018) found that farmers growing under the food safety modernization act (FSMA) cost much less productivity than other farmers. At the same time, among the growers implemented by FSMA, large farmers benefit more than small farmers. In pursuit of higher profits, farmers may choose to expand their planting scale. Therefore, hypothesis 6 is proposed.

Hypothesis 6: The scale effect has a significant positive effect on scale planting.

### 2.3. Study design

To obtain research data, a questionnaire survey was conducted for vegetable farmers, which was

based on the Likert scale. It mainly consists of two major parts, and the first part is the individual attributes of farmers, including age, gender, education level, planting years, self-owned arable land area, and the proportion of vegetable income in family income, etc. The second part includes production support policy, scale effect, price fluctuation degree, and large-scale planting.

To ensure the reliability and validity of measurement tools, scales are used in domestic and foreign literature (Table 1). Pre-survey was conducted before the finalized and formal survey to assess the questionnaire design and word appropriateness, which was modified appropriately according to the specific object and purpose of this study.

#### 2.4. Sampling strategy

The respondents of this study were vegetable planting farmers in Nanhe district, Xingtai city, Hebei province. The data source from 207 vegetable planting farmers was collected in June 2021 and analyzed. The farmers were randomly selected from five villages, concluding Dongzhengzhuang Village, Dalin Village, Wutun Village, Qie Village, Southeast Zhang Village and Xingzhou Modern agricultural and sideline

products International logistics Center. They were representative villages of vegetable planting in the Nanhe district. The planting and sales of vegetables in these areas are relatively concentrated, and the farmers have many years of planting experience, which has a good investigation role in this research.

#### 2.5. Reliability and validity analysis

The reliability and validity of the questionnaire were tested (Table 2). The intrinsic reliability analysis is shown that the value of Cronbach's  $\alpha$  for each latent variable of the questionnaire was 0.816. The Cronbach's  $\alpha$  values for the four latent variables were 0.788, 0.811, 0.798, and 0.814, which all meet the requirements of greater than 0.7. It means that the setting of the question item has good correlation and consistency, which can achieve the research purpose. The KMO and Bartlett sphericity tests were performed on the data. The results showed that the KMO test coefficient of the questionnaire was 0.746, greater than 0.5. The Bartlett sphericity test has an approximate chi-square value of 525.835 and a P-value of 0.000, less than 0.001. It shows that the questionnaire has structural validity and is suitable for factor analysis. The confirmatory

Table 2. Test of the reliability and validity of the factor variables

latent variable	observable variable	factor loading	Cronbach $\alpha$ coefficient
Production support policy	The government provides financial support (industrial subsidies and financial credit support).	0.766	0.788
	The government provides construction support for infrastructure (agricultural machinery purchase subsidy, vegetable standardized park construction subsidy...).	0.671	
	The government conducts industrial training and policy publicity.	0.636	
	At present, there are many channels to obtain vegetable production policy support, and the procedure is simple.	0.722	
Scale effect	The income of vegetable planting is affected by the planting scale.	0.76	0.811
	Farmers with large-of vegetables are more likely to benefit.	0.761	
Price fluctuation degree	The government encourages farmers to expand the scale of vegetables and gives corresponding support.	0.579	0.798
	Vegetable planting is easily affected by the fluctuation degree of vegetable market price.	0.616	
	The fluctuation degree of vegetable price will affect the planting scale of farmers.	0.481	
Large-scale planting	The government has carried out policy regulation to stabilize the vegetable market prices.	0.487	0.814
	Expanding vegetable planting scale can increase family income.	0.534	
	Expanding the scale of vegetable planting is in line with the current market situation.	0.645	
	There are currently plans to expand the scale of vegetable planting.	0.728	

factor analysis of the questionnaire was conducted, using SPSS 26.0. And the factor load of the observed variables ranged from 0.487 to 0.766, overall greater than 0.5. It shows that the

observed variables set have reliable validity and can be used for the analysis.

Table 3. Sample feature description

Variables	Characteristics	Frequency	Percentage	Variables	Characteristics	Frequency	Percentage
Gender	Male	134	65%	Vegetable planting area	<0.5 acres	38	18.3%
	Female	73	35%		0.5~0.8 acres	80	38.5%
Age	<35 Years	0	0%		0.8~1.15 acres	36	17.4%
	36-40 years	6	3%	1.15~1.5 acres	13	6.4%	
	41-45 years	30	14.4%	>1.6 acres	40	19.4%	
	46-50 years	82	39.6%	Planting years	<3 years	19	9%
	>51 years	89	43%		3-5 years	34	16.5%
Education	Below Primary school	5	2%		5-7 years	25	12%
	Primary school	58	28%	7-9 years	40	19.3%	
	Primary school junior high			>9 years	89	43.2%	
	High school / technical secondary school	25	12%	The proportion of vegetable planting income in household income	<20%	0	0%
	College degree or above	4	2%		20%-40%	8	4%
	Number of household labor	1	9		4.6%	40%-60%	14
2		130	63%		60%-80%	51	24.8%
3		57	27.3%	>80%	134	64.7%	
4 and above		11	5.1%				

### 3. Results

#### 3.1. Descriptive statistics

Descriptive statistics of the used variables in this study are revealed in Table 3. Results reveal that only 3% of vegetable farmers are under the age of 40, which indicates that the farmers engaged in vegetable farming in the survey areas were generally older. Most of the farmers were over 45 years old, accounting for 82.5% of the total respondents. Among the respondents, Farmers with an education level below junior middle school accounted for 30% and farmers above junior high school and below accounted for 70%. This also shows that the education level of the vegetable planting farmers in the survey area is mostly at the junior middle school level. Compulsory education is relatively much more universalized. According to the survey, 94.9% of rural households have less than three people. It indicates that vegetable planting is mostly

contracted by household units. It's found that 19.4% of large vegetable growers have a planting area of more than 1.6 acres, and most farmers have 2-4 vegetable greenhouses, covering an area of about 0.5~1.5 acres. And 74.5% of the farmers' vegetable planting years in more than 5 years.

At the same time, 64.7% of farmers' vegetable planting income has accounted for more than 80% of their total family income. It shows that the region has been engaged in the development of the vegetable industry for a long time. Most of the farmers have long experience in vegetable planting, and the planting area of the farmers is also expanding. Vegetables have become the main industry to increase the income of the farmers in the region.

#### 3.2. Analysis of the latent and observed variables

The overall levels of the production support policy, price fluctuation degree, scale effect, and large-scale planting are shown in Table 4 and Table 5. The core of each observed variable ranged from 5 to 1, indicating strongly agree, agree, neutral, disagree, and strongly disagree.

The mean value of the four observed variables of the production support policy was higher than the neutral evaluation value of 3, ranging between

2.64 and 3.49. It was found that most farmers said that they could enjoy less vegetable production support policies, the scope of subsidies is small, the amount is low, and the subsidy funds are not issued in time. In general, farmers are less satisfied with the local production support policies. The mean value of the 3 observed variables for price fluctuation degree is between 2.63 and 4.5, which is generally above the neutral evaluation value of 3. It is found that in the survey, most farmers think that the vegetable market price fluctuates greatly, affecting the vegetable planting scale of farmers. And they think the role of the government in stabilizing vegetable market prices is mediocre.

### 3.3. Model analysis of the structural equations

#### 3.3.1. Model matched with moderate test

There are more than 20 metrics testing the adaptation of structural equation models. In this paper,  $\chi^2$ ,  $\chi^2 / df$ , GFI, AGFI, RMSEA, IFI, TLI, and CFI were selected. Model adaptation criteria after performing the theoretical model after constant corrections are shown in Table 6.

#### 3.3.2. SEM path coefficient

In this paper, the model was parameter estimated, and the path coefficients of the structural models are shown in Table 7. The standardized path coefficients of the structural equations were used to illustrate the relationship between the variables

Table 4. Descriptive statistics of the latent variables

Latent variable	Number	Observational variable questions	Mean value	standard deviation
Production support policy	PSP1	The government provides financial support (industrial subsidies and financial credit support).	3.02	1.029
	PSP2	The government provides construction support for infrastructure (agricultural machinery purchase subsidy, vegetable standardized park construction subsidy...).	2.89	0.986
	PSP3	The government conducts industrial training and policy publicity.	3.49	0.996
	PSP4	At present, there are many channels to obtain vegetable production policy support, and the procedure is simple.	2.64	0.828
Price fluctuation degree	PFD1	Vegetable planting is easily affected by the fluctuation degree of vegetable market price.	4.5	0.608
	PFD2	The fluctuation degree of vegetable price will affect the planting scale of farmers.	3.73	0.985
	PFD3	The government has carried out policy regulation to stabilize the vegetable market prices.	2.63	0.766

The overall level of scale effect and large-scale planting is shown in Table 5. The values of the three observed variables for economies of scale were 4.05, 3.87, and 2.63 with overall neutral evaluation values greater than 3. It shows that most farmers think that the scale of planting is closely related to profit. The mean of the three observed variables for large-scale planting was 3.5, higher than the neutral level of 3. It shows that farmers in the surveyed area generally have a positive attitude towards vegetable scale, and may be reluctant to expand the scale of vegetable planting due to age, family labor force, or vegetable market conditions.

within the model, with larger values indicating a stronger degree of association. The P-value of the path coefficient test was used to determine the significance of this pathway coefficient and thus whether there were significant effects between variables. The path coefficient of the production support policy on the scale effect is 0.35, the path coefficient for the degree of price fluctuation is 0.62, and the path coefficient for large-scale planting is 0.12. The path coefficient of the degree of price fluctuation on the scale effect and the scale planting is 0.19 and 0.72, respectively. The path coefficient of scale effect on scale planting was 0.32. From the significance of the P-values of each path coefficient, the production support policy has a significant effect on price fluctuation and scale effect, the price fluctuation has a



significant effect on large-scale planting, and the scale effect has a significant effect on large-scale planting. However, the significance test of the P-value of the production support policy for large-scale planting and the price fluctuation degree to the scale benefit is greater than 0.05 level. The reasons for which it is not directly related remain to be examined.

between the variables, and test whether the variables have significant effects through mediation variables, the mediation effect test method used in this paper is the Bootstrapping self-help method. The repeated sampling technique was used to construct confidence intervals for confidence intervals of various effects. The bootstrap method partly overcomes the confidence interval estimation bias problem

Table 5. Descriptive statistics of the latent variables

latent variable	Number	Observational variable questions	Mean value	Standard deviation
Scale effect	SE1	The income of vegetable planting is affected by the planting scale.	4.05	0.646
	SE2	Farmers with large-of vegetables are more likely to benefit.	3.87	0.66
	SE3	The government encourages farmers to expand the scale of vegetables and gives corresponding support.	2.63	0.721
Large-scale planting	SP1	Expanding the scale of vegetable planting is in line with the current market situation.	3.91	0.722
	SP2	There are currently plans to expand the scale of vegetable planting.	3.52	0.673
	SP3	Expanding the scale of vegetable planting is in line with the current market situation.	2.97	0.97

Table 6. Index for model fit

Index	Model with moderate index name							
	$\chi^2$	$\chi^2/df$	GFI	AGF	RMSEA	IFI	TLI	CFI
Index value	118.788	2.159	0.927	0.9	0.07	0.927	0.903	0.925
Reference value	The smaller the better	<3	>0.9	>0.9	<0.08	>0.9	>0.9	>0.9

Table 7. Structural model path coefficient

Configuration	Standardized estimates	S.E.	C.R.	P
PFD <--- PSP	0.623	0.043	3.738	***
SE <--- PFD	0.189	0.089	0.521	0.602
SE <--- PSP	0.352	0.03	1.304	**
SP <--- SE	0.319	0.161	1.981	**
SP <--- PSP	0.127	0.051	0.706	0.48
SP <--- PFD	0.717	0.225	2.838	**

Note: \*, \*\*, \*\*\* indicate that the statistical tests are at 10%, 5%, and 1% significant levels, respectively

### 3.4. Mediation effect test

From the result of model estimation, the direct effect of price fluctuation degree on scale benefit and production support policy on scale planting is not significant. In order to verify the relationship

caused by the non-normal distribution of the mediation effect. It is the most effective mediation effect test method at present. Therefore, this approach is used to perform the mediation effect test. The results of the mediation effect test are shown in Table 8.

The Bootstrapping results are shown that when large-scale planting is used as the mediation variable, both the indirect effect and the direct effect confidence interval of the price fluctuation degree on the scale effect do not include 0. It indicates that the total effect and the indirect effects are significant. The value of the mediation effect was 0.0509, and the total effect value was 0.2643.

by local governments can increase vegetable output to a certain extent and bring internal economies of scale (Schreinemachers et al., 2016). Production support policy has a significant impact on price fluctuation degree, and hypothesis 3 is supported. It shows that the production support policy has a positive effect on the vegetable market, affects the fluctuation of vegetable prices (Kong et al., 2019), and helps to

Table 8. Bootstrapping total effect, direct effect, and indirect effects report

Variables	Effect	Bootstrapping		
		BootLLCI	BootULCI	
PFD→SE	Total effect	PFD→SE	0.1576	0.3709
	Direct effect	PFD→SE	0.0989	0.3277
	indirect effect	PFD→SP→SE	0.0095	0.1035
PSP→SP	Total effect	PSP→SP	0.0693	0.2619
	Direct effect	PSP→SP	-0.0439	0.1583
	indirect effect	PSP→PFD→SP	0.0538	0.1671

The mediation variable mediates about 19 % of the effect, which is an incomplete mediation model. It indicates that the price fluctuation degree may affect the decision of farmers to expand the planting scale and thus have a positive impact on the scale benefit of vegetable planting in this region. When the influence of production support policy on scale planting is studied with the price fluctuation degree as the intermediary variable, the indirect effect confidence interval does not include 0. The direct effect confidence interval includes 0, the total effect and the indirect effects were significant, and the direct effect was not significant, which is, therefore, a fully mediated model. It shows that the impact of production support policies on large-scale planting is entirely due to the impact of production support policies on price fluctuation degree, which make the market situation change better. Thus, it has a positive impact on the scale of vegetable planting farmers.

**4. Discussion**

Production support policies have a significant impact on the scale effect. Hypothesis 1 is supported, which shows that the product support policy plays an important role in promoting vegetable industrialization and scale. Policies such as land transfer subsidies, production material subsidies, and agricultural production technology training and promotion implemented

stabilize the vegetable market price (Gu and Wang 2020). To a certain extent, it can reduce the economic losses caused by the drastic fluctuations in vegetable prices and improve the family income.

Price fluctuation degree has a significant impact on large-scale planting, and hypothesis 5 is supported. It indicates that when the vegetable market is better and the price fluctuation is small, it has a greater impact on the decision of farmers to expand the scale of vegetable planting. Vegetable price fluctuation is directly related to the planting income of farmers, which affects their planting decisions in the next year. Farmers with different planting sizes are differently affected by price fluctuations (Ding and Rebessi 2020). The scale effect has a significant positive impact on large-scale planting, and hypothesis 6 is supported. It shows that the stronger the scale benefit of vegetable planting, the more likely farmers are to expand the scale of vegetable planting (Dong et al., 2019). The scale effect represents the economic benefits of vegetables. A high-scale effect may mean a high land yield. The overall market is booming. The agricultural division of labor and organization effect is obvious. In this case, the planting scale can be expanded.

The direct effect of the production support policy on large-scale planting is not significant, and hypothesis 2 is not supported. However, the mediation effect of scale effect and large-scale

planting through price fluctuation degree exists. It indicates that the production support policies may affect the scale through price fluctuations degree. At present, the most important factor affecting farmers' planting decisions is the change in the vegetable market situation, which directly affects farmers' vegetable planting income, thus affecting whether farmers expand the planting scale. The supporting policies for the income of vegetable planting farmers are mainly reflected in reducing the production input cost and increasing farmers' wage income or transfer income (Qian, Ito, and Zhao 2020). Agricultural subsidies can increase vegetable production by increasing the input level of agricultural production factors and reducing the level of the labor force and may not directly increase production by expanding the planting scale. Therefore, production support policies have a small role in directly expanding the scale of vegetable cultivation (Chen et al., 2022).

However, the implementation of the production support policy can stabilize the vegetable market price and improve the vegetable market, to improve the enthusiasm of farmers to expand the scale of vegetable planting. The direct effect of the price fluctuation degree on the scale effect is not significant, and hypothesis 4 is not supported. However, the mediation effect of scale effect through large-scale planting exists. It indicates that the price fluctuation degree may affect the scale effect through large-scale planting. Price fluctuations degree directly affect the vegetable market conditions, thus affecting the income of farmers. The scale effect is mainly reflected in the continuous improvement of land yield rate and agricultural scale (Yang and Li 2019). Scale effect has a direct impact on large-scale planting, and the market changes may directly affect the decision of farmers' future planting scale. At the same time, changes in market conditions may encourage small business farmers to start to cooperate with large cooperatives to form an interest connection mechanism, which can improve the degree of the regional organization. The vegetable planting is gradually intensive and large-scale, which continuously increases the scale benefit of regional vegetables (Huang and Ding 2016). Therefore, the price fluctuation degree has an indirect impact on the scale effect through the large-scale regional vegetable planting.

## 5. Conclusion

Based on the field data of vegetable planting farmers in the Nanhe district, Xingtai city, Hebei province, this paper summarizes the impact of the current production support policies on the

vegetable planting scale. The influence relationship of production support policy on vegetable planting scale was explored. It is verified by proposing an estimated model using structural equations. The structural equation model results are shown that the product support policy has a significant positive impact on the scale effect and the price fluctuation degree. It shows that the product support policy plays an important role in stabilizing vegetable market prices, improving the scale effect of the vegetable industry, playing the role of scale economy, and promoting the scale of regional vegetables. The scale effect and the price fluctuation degree have a significant positive impact on the scale planting. It indicates that the higher the scale of vegetable planting, the stronger the ability of farmers to resist risk. When the vegetable market is better and the price fluctuation is small, it has a greater impact on the decision of farmers to expand the scale of vegetable planting.

The Bootstrapping results showed that the production support policy had no direct and significant impact on the large-scale planting. However, the mediation effect on large-scale planting produced through the price fluctuation degree does exist. It indicates that the production support policies may affect the large-scale planting through the degree of price fluctuations. The price fluctuation degree has no direct effect on the scale effect, but the mediation effect on the scale effect produced through scale planting exists. It indicates that the price fluctuations degree may affect the scale effect through large-scale planting.

The conclusions of this study have some policy implications. On the one hand, it is necessary to increase the content of policy subsidies and improve the policy system. The focus of vegetable production support policies should not be limited to traditional agricultural subsidies but should be based on reality and formulate more effective policies for farmers to improve the farming and business environment. It is necessary to increase financial investment, innovate the policy-based agricultural insurance system, increase the input level of support policies for vegetable production factors and the level of the labor force, and increase the transfer income and wage income of farmers. On the other hand, strengthen policy implementation and expand the scope of policy support. It's necessary to expand the scope of current vegetable production support policies and increase policy input to family farmers. Provide infrastructure construction and agricultural material supply support, ensuring timely

distribution of subsidies and implementation of policies.

Secondly, it is necessary to increase technical training and increase the frequency of grass-roots technical promotion services. Technical services cannot be limited only to co-operatives and family farms. It's needed to attach importance to the training of professional farmers, improve the level of planting technology, and cultivate more farmers with professional ability. In addition, local governments should strengthen the assessment of policy implementation, timely review the implementation of local vegetable production subsidy policies, and strengthen supervision. Finally, in order to better promote the large-scale development of the regional vegetable industry, it is necessary to strengthen the cooperation between scale operators and farmers. The organizational function and operational advantages of agricultural cooperatives should be exerted, gather the scattered farmers and carry out scale operations. It is helpful to avoid the economic risks brought about by excessive market price fluctuations, stabilize the market situation, improve the income of farmers, and promote the intensive and large-scale development of the regional vegetable industry.

### Limitations of the Study

Limited to the research level, this study has the following insufficiency.

First, the data sample size of this study was small to some degree. Second, the questionnaire design is not complete enough. The data obtained are not detailed enough to objectively reflect the real attitude of farmers. In future research, follow-up surveys can be carried out and follow-up visits to farmers in the research areas. The data from different periods can be obtained to further verify the causal relationship between the variables in the model. Second, it's needed to increase the survey area, expand the sample coverage, and further verify the conclusions of this study.

### Acknowledgment

This research is supported by the National Science Foundation of China (NO.71873052).

### Conflict of Interest

Auhtors declare no conflict of interest.

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